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TSG/APSD/IEB-136/70
26 August 1970

MEMORANDUM FOR: Chief, Image Evaluation Branch, APSD/TSG/NPIC

SUBJECT: Implementation of the Operational Handbook for
Evaluation of Original Negative

1. The Operational Handbook for Evaluation of Original Negative was prepared for APSD by [redacted] under Contract [redacted] Task Order Number Two. The handbook was delivered in January 1970, and is comprised of 277 pages of documentation, not including five block diagrams and 59 pages of reference literature. The handbook is a detailed explanation of [redacted] concept of original negative image evaluation as it would fulfill the needs of the exploitation community.

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DOCUMENTATION

2. The general format of the book is comprised of the following parts:

Introduction	6 pages
Theoretical Background	68 pages
Implementation	4 pages
System Flow Chart Explanation	D9 pages

The Introduction describes [redacted] philosophy in designing the handbook and presents an overview of the remainder of the volume. The Theoretical Background presents a general summary of basic photographic science principles and relates how these principles can be applied to high altitude reconnaissance. Image quality analysis and tonal rendition receive the greatest emphasis. The Implementation section lists [redacted] suggested sequence of implementation and recommends areas of further research. The System Flow Chart Explanation documents Info Tech's concept of the sequence of procedures for APSD to follow in original negative evaluation. The flow chart documentation is sketchy in organization. For example, seven extra blocks are documented in one section of the handbook but are omitted from the flow chart diagrams. Several topics are treated only in a cursory manner and practical implementation requires extensive analysis.

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3. The documentation in the Handbook is keyed to five system flow charts; (1) Master System Diagram, (2) Data Collection and Generation of Files, (3) Mission Interpretability Summary, (4) Duplicate Potential Summary, and (5) Mission Mensuration Potential Summary. The Master System Diagram (page A1) outlines the overall evaluation scheme. Three basic functions are performed to complete the evaluation; selection of targets, data collection and generation of files, and generation of three suitability summaries. The flow charts for the data collection and generation of files and three suitability summaries are shown on pages A2-A5.

RECOMMENDATIONS

4. After examination of these five flow charts, I recommend the following:

a. The Data Collection and Generation of Files (page A2) be implemented in its entirety.

b. The Duplicate Potential Summary (page A3) be partially implemented in coordination with the present Duplicate Product Evaluation Contract.

c. The Mission Mensuration Potential Summary (page A4) not be implemented until further research is conducted by IEG/PHD and TSG/APSD.

d. The Mission Interpretability Summary (page A5) not be implemented until research is completed in the correlation of engineering parameters to photo interpreter performance.

5. The Data Collection and Generation of Files (page A2) encompasses the collection and computation of parameters necessary for image evaluation. The procedure is broken down into two major sections: tonal data analysis and spatial image quality analysis. The tonal data analysis generates information which will enable the technologist to evaluate exposure, duplication potential, and exposure effects on photo interpretation. Density data is analyzed as a function of ground reflectance through a knowledge of exposure, camera, atmosphere, illumination and standard target data. The image quality analysis uses a microdensitometric edge trace to compute MTF, acutance, and spread function. This data is used to evaluate photo

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interpretation and mensuration suitability. The theoretical background for the computation of this data is derived from well proven principles and the mathematical formulation exists for each item being calculated. However, there appear to be some problems to the practical application of the theory:

a. The generation and storage of data requires an extensive computer programming effort, both in manpower and computer files space (see page 92 of the handbook).

b. Present computerized techniques of edge smoothing are not satisfactory in some cases.

c. Dual gamma processing of the original negative provides a major source of error in MTF calculation in that exposure cannot be adequately determined from density because of adjacency effects. The adjacency effect can be reduced if densities used in the calculations are below 1.5, but to what extent the error is reduced is not known.

d. The data derived from page A2 may not be complete. For example, recent developments in power spectrum analysis indicate that information from this area may be an excellent supplement to the parameters already generated on page A2. In addition, a classic four quadrant tone reproduction diagram might also be added.

The major advantage to implementing the data generation phase (page A2) is that APSD/IEB will then have the capability of generating important image quality evaluation parameters on a target and mission basis. APSD/IEB could then apply these numbers to engineering evaluation of film and systems, and investigate the correlation of each to photographic interpretation suitability. The tonal evaluation data will indicate original negative exposure error, haze problems, and duplicating techniques required for individual frames.

6. The Duplicate Potential Summary (page A3) for the original negative can be investigated and implemented as the Duplicate Product Evaluation Contract progresses. Two objectives of the Duplicate Contract are to implement a monitoring procedure of duplicate specifications and a means for updating duplicate specifications. The duplicate potential of the original negative is directly dependent on the specifications of the duplicating process. It would be advantageous to

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have a computerized correlation of original negative duplicate potential, duplicate specifications, and duplicate product evaluation.

7. The Mission Mensuration Potential Summary (Page A4) cannot be implemented. A required input to this summary is a mensuration error model which is not available at this time. APSD/IEB, APSD/ISAB and IEG/PHD can coordinate in this area. Each Division at present is conducting an investigation into particular aspects of the problem but no attempt has been made to assimilate the data into a Mensuration Potential Summary for the original negative.

8. The Mission Interpretability Summary (page A5) could be implemented in its entirety after the Data Collection and Generation of Files (page A2) is completed. However, no evidence exists that the numbers generated in the Mission Interpretability Summary will be any more valuable in indicating interpreter performance than techniques already available, ie, resolution and MIP. Other organizations are presently investigating, or propose investigating the correlation of engineering parameters to photo interpreter performance. A photo interpretation suitability summary from mission material would have meaning only after a positive correlation is available. The IEB effort in this area should first be applied to investigating the relationships of engineering data to the needs of the photo interpreter. This should be done in the light of the proposed Photo Interpretation Suitability Summary (page A5) rather than in spite of it. After Data Collection and Generation of Files (page A2) is implemented, APSD would have the capability of conducting some aspects of an investigation in-house. The mission material, photo interpreters, intelligence reports, and engineering data would be available first hand, and the requirement would be to design a valid experiment and correlate the data.

IMPLEMENTATION SEQUENCE

9. In order to properly utilize the limited number of personnel and manhours which can be devoted to this project, the sequence of effort on page 5 is proposed. The sequence is divided into phases and each phase would have a definite goal and procedure for implementation. In most cases one phase can begin before another is completed but haste in implementation cannot substitute for well founded background work. The proposed sequence is only a general one with indicated dates being approximate. Two analysts from IEB with assistance from ISAB, IEG/PHD and PSG/AID would be required to implement the procedure on a timely basis. A lesser commitment of manpower would proportionately reduce the implementation effort.

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10. The implementation of the Data Collection and Generation of Files (Phase 1) and validation of the data (Phase 2) are already underway in APSD. The image quality evaluation section is presently being analyzed and programmed. An acutance routine with a statistical target by target accumulation of data is available in FORTRAN in IEB. The microdensitometry edge trace smoothing routine, exposure generation, and MTF is presently being programmed in AID under guidance from ISAB.

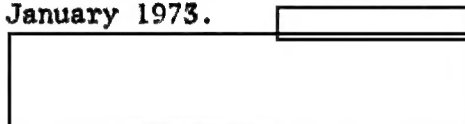
11. Eighty percent of the tonal evaluation has been analyzed and programmed in FORTRAN by IEB. A test procedure for evaluating the tonal program on operational imagery is presently being designed. The remainder of work to be done in the Data Collection and Generation of Files is shown in the following table:

<u>CALCULATION</u>	<u>ESTIMATED DATE OF COMPLETION</u>
MTF	Nov 70
Spread Function	Dec 70
MTFA	Mar 71
STD Target Tri-Bar Est.	Mar 71
Scale Res. to Ground	Mar 71
Scale MTFA to Ground	Apr 71
Statistical Accumulation	Jun 71

12. The Duplicate Product Evaluation Contract (Phase 3) with [redacted] is underway in APSD. The scheduled completion date is 18 May 1971. The remaining phases 4-10 are dependent on the progress of phases 1 - 3.

SUMMARY:

The Operational Handbook for Evaluation of Original Negative can be implemented, at least in part. The implementation should be coordinated with the Duplicate Product Evaluation Contract. Additional analysis should be conducted within APSD to assure the validity and usefulness of the resultant data. The entire scheme as described on page 5 could be operational by January 1973.



Section I
Image Evaluation Branch
APSD/TSG/NPIC

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Attachments:

A1 - A5 - A/S

Distribution:

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